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Single institution experience of single incision trans-umbilical laparoscopic cholecystectomy using conventional laparoscopic instruments

A.M. Abdelaziz Hassan, Magdy M.A. Elsebae*, Magid M.A. Nasr, A.I. Nafeh

Department of General Surgery, Theodore Bilharz Research Institute, P.O. Box 30, Imbaba, 12411 Giza, Egypt

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ABSTRACT

Background: Since the implement of laparoscopic cholecystectomy as the gold standard treatment for gall bladder stones, there has been a trend toward minimizing the required number and size of ports to reduce postoperative pain with better cosmetic results. We conducted this study to evaluate the feasibility, safety, advantages and complications of single incision laparoscopic cholecystectomy using the conventional laparoscopic instruments.

Methods and patients: Eighty patients (68 females and 12 males) with uncomplicated symptomatic gall bladder stones underwent elective laparoscopic cholecystectomy via single trans-umbilical incision using the conventional laparoscopic instruments.

Results: The mean operative time was 61.75 min (range: 40–105 min) and the mean estimated blood loss was 17.21 ml (range: 5–90 ml). Gall bladder perforation occurred in five cases (6.25%) with calculi spillage in four of them. It was managed by using laparoscopic stone removal forceps. Troublesome cystic artery bleeding occurred in 2 cases (2.5%) while gall bladder bed bleeding happened in one case (1.25%) with liver cirrhosis and managed by argon beam coagulation. An intraoperative cholangiography was performed in 3 cases and a drain was inserted in one case. There was no conversion to the open technique in any of the cases. 49 patients (94.2%) discharged on the 1st postoperative day and 3 patients (5.8%) discharged on the 2nd postoperative day. The average wound length measured on 3rd postoperative month was 1.58 cm (range, 1.3–2.1 mm); while average score of patient satisfaction of the surgery was of 9.32 (range, 7–10).

Conclusion: In uncomplicated gall bladder disease; single incision laparoscopic cholecystectomy is feasible and safe. It has an excellent esthetic results and high grade of patient satisfaction. It could be performed with the conventional laparoscopic instruments and its scale of application could be widened once enough experience attained.

1. Introduction

Traditionally, laparoscopic cholecystectomy has been performed with four ports on the principle of one instrument per port. The development of various ports has allowed the introduction of multiple instruments through a single port inserted at the umbilicus.[1–6] Reducing the size or number of ports was found safe procedure which further enhanced the advantages of laparoscopic over open cholecystectomy.[7,8] These modifications actually reduced the abdominal wall trauma, postoperative pain and analgesia requirement.[9,10] Furthermore, it appeared to be cosmetically superior to standard laparoscopic cholecystectomy.[11] During the past few years, there has been a trend to natural orifice transluminal endoscopic surgery (NOTES) with the access to the peritoneal cavity through natural orifices such as the mouth, vagina, and the like without violating the abdominal wall.[12] However, NOTES has proved very difficult to reproduce widely. Only a few centers have been successful in performing it safely.[13] Therefore, there has been resurgence for single-incision laparoscopic surgical techniques (SILS) using refinements of existing technology without any new instruments, specific competence or training.[14–19] We conducted this study to evaluate the feasibility, safety, advantages and complications of single incision laparoscopic cholecystectomy using conventional laparoscopic instruments.

2. Material and methods

2.1. Study design

Eighty patients with symptomatic gall bladder disease presented at the outpatient clinic of our institute were recruited for this study during the period from April 2010 to December 2011. Patients have been thoroughly evaluated before surgery by

* Corresponding author. Tel.: +20 2 33761499; fax: +20 1227281418.
E-mail address: magdyelsebae@hotmail.com (M.M.A. Elsebae).

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full clinical examination, routine laboratory testing and abdominal sonography. Patients included in the study were those with chronic calcular gall bladder disease with an overall good health (ASA I/II) and body mass index (BMI) $\leq$35 kg/m^2. Patients with complex biliary disease (acute cholecystitis, choledocholithiasis, history of jaundice, pancreatitis), prior history of upper surgical procedures and diseased umbilicus (hernia, inflammation, sinus…etc.) were excluded. All patients consented to a laparoscopic cholecystectomy with thorough explanation of having a single incision in the abdomen with the possibility of conversion to conventional laparoscopic cholecystectomy or open technique. This study was approved by the Ethics Committee of Theodore Bilharz Research Institute (TBRI). For all patients, the main author was part of the surgical crew and the surgical technique had been standardized.

2.2. Surgical technique

2.2.1. Position of the patient and surgical team

The patient was positioned supine with the legs split apart and strapped firmly to the leg boards with both upper and lower limbs abducted. A restraining belt placed at the level of the pelvis to secure the patient to the table. The surgeon stands between the legs of the patient and the assistant to stand on the left side and the scrubbing nurse on the right side.

2.2.2. Placement of ports

After pulling out the umbilicus, it was held with two-toothed forceps and a curved 15–20 mm incision was made through it using 11 mm blade taking care not to extend beyond the umbilical outer extremity. This was deepened through the fat then; the flaps are undermined to expose the fascia. A stab incision was made then; insertion of a 10 mm port was done. CO_2 pneumoperitoneum was induced and maintained at 12–14 mmHg for exploring the abdomen using 5 mm 30 degree laparoscope. The pressure was then decreased to 5 mmHg and insertion of another two 5 mm ports on either side of the camera port via the anterior layer of the rectus muscle was done, considering that both ports are above and lateral to the central camera port by 2–4 mm making a shape of a triangle. This was followed by increasing the pressure again to 12–14 mmHg. The patient position was changed to a reverse Trendelemburg position with a slight rotation to the patient's left side.

2.2.3. Placement of traction suture

A grasper was used to move the omentum away from the right upper quadrant so as to obtain a view of the fundus of the gall bladder. Then retraction of the gall bladder fundus in a cephalic lateral position was done. Maintenance of the fundus in such a position was kept by placing a suture on a straight needle through the abdominal wall just below the costal margin, passing through the gall bladder fundus, then through the abdominal wall and fixed on the skin.

2.2.4. Dissection of the Calot's triangle with control of the cystic artery and duct

Retraction of the Hartman's pouch was done by using non-traumatic grasper on the left 5 mm port. A retrograde dissection of the medial side of the Calot's triangle was performed by using Maryland's grasper or electric cautery dissecting hook on the right 5 mm port. Dissection of the lateral side of the Calot's was done after exchanging the sides of the mentioned instruments aiming for exposure of the critical view of safety of the cystic duct and artery. This was followed by clipping the artery and duct using two proximal clips and one distal clip per each.

2.2.5. Dissection of the gall bladder

After clipping is completed, dissection of the gall bladder from its liver bed was performed by using electric cautery dissecting hook. The fundal traction suture was loosened and the gall bladder was freed from the liver. After the achievement of meticulous hemostasis in the liver bed, removal of the gall bladder was done through the central port.

2.2.6. Closure of the incision

Closure of the anterior layer of the rectus muscle was performed by using 0 PDS on J shaped needle followed by subcuticular closure of the curved umbilical incision using 4/0 Monocryl restoring the umbilicus to its normal physiological position.

Operative data including operative time (from skin incision till closure), estimated blood loss, perforation of gall bladder with bile or calculi spillage and any other intraoperative incidents were recorded. Post-operatively all patients allowed to resume oral intake after full anesthetic recovery and encouraged early ambulation while systemic analgesia was reserved upon patient request. Patients discharged 24–48 h after surgery.

Each patient was followed on the 8th postoperative day for wound examination and stitch removal then after 3 month for assessment of the patient satisfaction (scored 0–10) and wound measurement of its linear dimensions using a tape measure was done. Operative and postoperative follow up data were collected and organized in an electronic spreadsheet (Microsoft excel®).

3. Results

Sixty-eight patients were women and twelve were men. Their mean age was 39.08 years (range 23–62 years). All had chronic calcular cholecystitis and underwent SILC. Demographic and preoperative data of the patients are shown in (Table 1).

The mean operative time was 61.75 min (range: 40–105 min). The mean estimated blood loss was 17.21 ml (range: 5–90 ml). Gall bladder perforation occurred in five cases (6.25%) with calculi spillage in four of them. It was managed by using laparoscopic stone removal forceps. Troublesome cystic artery bleeding occurred in two cases (2.5%). Gall bladder bed bleeding happened in one case with liver cirrhosis (1.25%) and it was managed by argon beam coagulation. An intraoperative cholangiography was performed in three cases. A drain was inserted in one case. There was no conversion to the open technique in any of the cases (Table 2).

Seventy-six patients (95%) discharged on the 1st postoperative day and 4 patients (5%) discharged on the 2nd postoperative day (one case for drain removal and another three cases for the requirement of parental analgesia). On the 8th postoperative day; two cases have had wound infection. It was managed by delay of stitch removal with frequent daily dressing for another 5 days. Otherwise, there were no other postoperative complications. Three months after surgery, average wound length was 1.58 cm (range: 1.3–2.1 cm).

Patient satisfaction score evaluated through a 10 grade analog scale. The average score of patient satisfaction of the surgery was 9.32 (range, 7–10). The most satisfying result was the excellent cosmetic result with the absence of a visible scar in most patients (Table 3).

4. Discussion

To achieve the most minimally invasive surgery for management of symptomatic gall bladder stones; two innovations have been recently developed namely NOTES, which removes abdominal incisions completely[12,13] and SILS, which completes laparoscopic procedures by trocars located at one umbilical incision.[15,16,20] However, single incision laparoscopic surgery seems more logic than NOTES, especially for surgeons who are familiar with and routinely perform laparoscopic surgery. It does not need the expensive and sophisticated infrastructure that NOTES may require. Also, the infrastructure needed to replicate surgical procedures with a single-incision laparoscopic platform appears to be quite straightforward and attainable by most practices. In addition, single-incision laparoscopic cholecystectomy can be performed with a combination of conventional laparoscopic instrumentation and novel devices especially designed for this technique.

Table 1
Patient's demographics and preoperative data.

Age mean & range (years)	39.08 (23–62)
Gender – *n* (%)	
Male	68 (85%)
Female	12 (15%)
Body Mass Index (BMI) mean & range (kg/m^2)	29.4 (22.3–36.8)
American Society of Anesthesiology (ASA) score – *n* (%)	
I	75 (93.75%)
II	5 (6.25%)
Past history – *n* (%)	
Appendectomy	4 (5%)
Gynecology/obstetric procedure	5 (6.25%)
Liver cirrhosis	4 (5%)
Diabetes mellitus	8 (10%)
Systemic hypertension	5 (6.25%)

Table 2
Intraoperative data.

Operative time (mean & range; min)	61.75 (40–105)
Estimated blood loss (mean & range; ml)	17.2 (15–90)
Complications – *n* (%)	
GB perforation	5 (6.25%)
Calculi spillage	4 (5%)
Cystic artery bleeding	2 (2.5%)
GB bed liver bleeding	1 (1.25%)
Drain insertion – *n* (%)	1 (1.25%)

Once great experience with concept of surgical laparoscopy through a single incision seems very conducive to safe, it may lend itself a bridge to NOTES because it promises the absence of a visible scar and potentially less pain than conventional laparoscopy.[21–24]

In our study, single incision laparoscopic surgeries were performed using conventional trocars, instruments and telescope. This avoids the increase in cost that is inevitable if we were to use reticulating instruments and the more expensive semi flexible laparoscope or special ports. It is worthy to be noticed that, as with any emergent technique, a very careful patient selection by using strict inclusion and exclusion criteria, especially at the beginning of one's experience, is of great importance. Once great experience is attained, these criteria could be expanded and relaxed.

Placement of the patient in a modified Lloyd Davis position allowed the surgeon and assistant to work together smoothly without conflict and with full range of movement. Also positioning of the ports in a triangular fashion was of great importance; making the telescope in the central port away from surgeon's working hands with respect of a crucial rule that the surgeon's right hand works on the lateral side of gall bladder while the left hand works on the medial side of the gall bladder. Placement of transabdominal traction sutures to suspend the gall bladder during laparoscopic cholecystectomy forms the key step of the SILC was originally described by Navarra et al. 1997.[14]

Intraoperative incidents were infrequent and could be corrected. Some challenges were faced during performing the procedure including clashing of instruments, deflection of laparoscope's light source by operating instruments, interference of wires which perpendicularly connected to instruments (i.e., cautery) and proprioception loss because of crossed instruments. These challenges contribute to an increase in the operative time. However, gaining experience could overcome those challenges. The length of the operative time is an important factor to be considered when evaluating any surgical procedure. A shorter time reduces the anesthetic time, bleeding, third space fluid shift and specifically in laparoscopic surgery, less exposure to carbon dioxide.[25,26] In our study the operative time was reasonable and can be lessened, especially when the challenges of this technique are better understood and solutions are being implemented. There was no mortality and no incidence of severe complications such as biliary tract or hepatic artery injuries during three months of follow-up.

Our study aimed at evaluation of the influence of the healing process on the size of the scars; therefore measurements were done three month after surgery. Concerning the optimizing of cosmetic results, patient satisfaction had been evaluated after the same period and both were encouraging which implies that esthetic satisfaction may be one of the desired outcomes expected by patients submitted to cholecystectomy. Concerns about the likely higher incidence of port-site hernias due to the use of multiple closely placed fascial incisions through a narrow area should be prevented by careful and secure closure of fascial defect at the umbilicus. Moreover, a long-term follow-up is required to assess the incidence of port-site hernias.

Table 3
Postoperative data.

Hospital stay – *n* (%)	
1 day	76 (95%)
2 days	4 (5%)
Wound infection – *n* (%)	2 (2.5%)
Wound length (mean & range; cm)	1.58 (1.3–2.1)
Patient satisfaction score (mean & range)	9.32 (7–10)

5. Conclusion

In uncomplicated gall bladder disease; single incision laparoscopic cholecystectomy is feasible and safe. It has an excellent esthetic results and high grade of patient satisfaction. It could be performed with the conventional laparoscopic instruments and its scale of application could be widened once enough experience attained.

Ethical approval

Ethical Approval was given by the Local ethical committee of Theodore Bilharz Medical research Institute. Ref. No. 119 on April, 2010.

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None.

Author contribution

All authors contributed to study design, data collections, data analysis, as well as, to the surgical procedures.

Data analysis, writing was executed by the corresponding author and revised by other authors.

Other contributors, including surgical residents have contributed to patients' care collecting and documenting the patients data.

Conflict of interest

None declared.

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